A systematic review of the limitations and approaches to improve detection and management of peripheral arterial disease in Hispanics

Eric B. Rosero, MD,[a] Katherine Kane, MD,[a] G. Patrick Clagett, MD,[a] and **Carlos H. Timaran, MD,[a,b]** *Dallas, Tex*

Peripheral arterial disease (PAD) is a highly prevalent public health problem associated with major detrimental effects on quality of life and functional status, and it is also the main cause of limb amputation. More importantly, PAD has been classified as a coronary artery disease equivalent, meaning that patients with a diagnosis of PAD carry a risk for major coronary events equal to that of established coronary artery disease. PAD is also a potent predictor of stroke and death. Despite its frequent occurrence (8 to 10 million Americans are affected), little is known about the natural history of PAD in racial/ethnic minorities, particularly in Hispanics, who represent 12.5% of the United States population. Furthermore, the disease is commonly underdiagnosed and undertreated in this minority group, and outcomes are poorer in Hispanics as compared with whites. Limited access to health care, difficulties for recruitment in population-based studies, and limitations of the noninvasive screening tests are well-established barriers to determine the prevalence and natural history of PAD in Hispanics. Although the most widely used test for assessment of patients at risk for PAD is the ankle-brachial index (ABI), the test has substantial limitations in individuals with diabetes and arterial calcification, which are highly prevalent in Hispanics. The ABI should, therefore, be supplemented by the use of other noninvasive tests, such as the pulse volume recordings (PVR) and toe-brachial index. Besides the use of a combination of diagnostic techniques, the implementation of a research methodology that improves recruitment of Hispanics in population-based studies is necessary to obtain better knowledge of the epidemiology of the disease in this group. Community-based participatory research may be the most appropriate approach to study this ethnic minority because it overcomes barriers for limited access to health care and increases the possibility of overcoming distrust of research on the part of communities. Understanding the epidemiology of PAD to improve its detection and treatment among Hispanics is relevant to reduce disparities in the health status of this group, the most rapidly growing ethnic minority in the United States. (J Vasc Surg 2010;51:27S-35S.)

EPIDEMIOLOGY AND NATURAL HISTORY OF PERIPHERAL ARTERIAL DISEASE

Although in a broad sense the term *peripheral arterial disease* (PAD) encompasses a large series of disorders that affect arterial beds exclusive of the coronary arteries, for the purpose of this review, PAD refers to atherosclerotic occlusive disease of the arterial system of the lower extremities (ie, the infrarenal aorta and/or arteries distal to the aortic bifurcation).[1] PAD is a highly prevalent public health problem affecting 8 to 10 million Americans and up to 29% of individuals age 55 or older.[1-4] Because PAD is a marker of systemic atherosclerosis, which also includes coronary and cerebrovascular artery disease, individuals with PAD have a seven- to 10-fold increased risk of cardiovascular ischemic events and a three-fold increased short-term mortality compared with age-matched individuals (Fig).[1,2,5-8] PAD is also associated with a major detrimental effect on quality of life, particularly when individuals with lower extremity PAD present with atypical pain or intermittent claudication (ie, the occurrence of calf, hip, and/or buttock pain or discomfort on walking that is relieved with rest).[1,3,9,10] Individuals with PAD thus experience a more rapid functional decline and impairment of leg function, which frequently result in significant loss of mobility and ability to perform daily living activities.[11,12] As the population ages and its oldest segment expands, the prevalence of PAD and its associated disability will certainly result in increased health care burden and expenditures.

The prevalence of PAD in the general population in individuals older than 55 years has been estimated to be between 3% and 29%.[5,6,13,14] These data are, however, based on population-based studies including predominantly non-Hispanic white individuals. The prevalence of PAD rises with age and has been found to be approximately 20% in people over 70 years of age[5,6,13-15] and up to 60% in the over 85-year age group.[6] Although previous studies have shown variations in the prevalence of this disease among different ethnic groups,[16-20] the prevalence of PAD in Hispanic populations, however, has not been extensively studied. The purpose of this article is to provide an over-

From the Division of Vascular and Endovascular Surgery, Department of Surgery, University of Texas;[a] and the Southwestern Medical Center and Veterans Affairs North Texas Health Care System.[b]

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Reprint requests: Carlos H. Timaran, MD, University of Texas Southwestern Medical Center, 5909 Harry Hines Blvd., Dallas, TX 75390-9157 (e-mail: carlos.timaran@utsouthwestern.edu).

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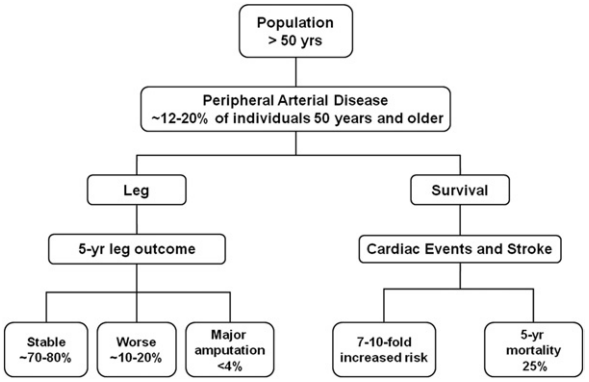

Fig. Natural history of peripheral arterial disease (PAD). Data have been derived from studies that have included primarily non-Hispanic white populations. *Leg* refers to the impact of PAD on lower extremity symptoms and prognosis. *Survival* refers to the effect of the disease on the patient's mortality, which is related to the increased risk of stroke and cardiac events.

view of data available on the epidemiology, diagnostic methods, and treatment of PAD in Hispanics as well as the limitations and possible approaches to improve its detection and management.

HISPANICS IN THE US POPULATION

Hispanics represent 12.5% (35 million) of the US population according to the 2000 US census. Most Hispanics indicated their race category as white (47.9%) or "some other race" (42.2%) in the census questionnaire. By 2050, an estimated 102 million Hispanics will reside in the United States, nearly 24.5% of the total US population.[21] Current health policies in the US, contained in the *Healthy People 2010* initiative, insist on improving quality of life and eliminating racial and ethnic disparities in health status as the two primary goals.[22] Such objectives can only be fulfilled if complete understanding of PAD in different ethnic groups is achieved.[9] Moreover, the effects of acculturation and socioeconomic factors on the prevalence and severity of PAD need to be investigated. If Hispanics experience poorer health status, this expected demographic change will magnify the adverse economic, social, and health impact of such disparities.[23] A critical need of research studies exists to define the true prevalence and natural history of PAD in Hispanics. Moreover, immediate action to enhance health promotion and lifestyle changes is also required.

PREVALENCE OF PAD IN HISPANICS

Differences in the evolution and prevalence of PAD across ethnic groups have been demonstrated. However, most available observational studies assessing PAD among Hispanics have included primarily hospital-based and clinical settings, which are prone to individual selection bias. Few population-based studies have examined the relationship between race/ethnicity and lower-extremity PAD. Prevalence estimates for Hispanics have varied widely, with rates in the range of 1.8% to 13.7%.[2,17,18] In a report from the National Health and Nutrition Examination Survey (NHANES), non-Hispanic blacks had the highest prevalence of PAD, whereas Mexican Americans had levels that were higher than whites but lower than blacks.[20] Similarly, the San Antonio Heart Study reported 61% greater odds of PAD among Mexican Americans than among non-Hispanic whites.[24] Conversely, two recent population-based studies revealed opposite findings. The Multi-Ethnic Study of Atherosclerosis (MESA) confirmed results from the San Diego Population Study, which evaluated non-Hispanic-whites, African-Americans, Hispanics, and Asians, found a significant excess of PAD in blacks independent of traditional vascular risk factors and lower prevalence in Hispanics.[17,25,26] However, these two studies have important limitations regarding the generalizability of their results to the general population. In the MESA study, individuals with cardiovascular disease were excluded, whereas in the San Diego Population Study, only university employees with health insurance were included. Moreover, individuals with an ankle-brachial index (ABI) greater than 1.4 were excluded from the analysis in the MESA study, which could have eliminated individuals with PAD with vascular calcification. All the barriers that limit the access of the Hispanic population to the health care system have played a role in the difficulties found by the investigators to determine the true prevalence of PAD in this ethnic group.

DIAGNOSIS OF PAD

Medical history

The natural history and clinical presentation of PAD need to be considered for its early recognition. Unfortunately, ethnic differences in the natural history of PAD have not been established. As with most atherosclerotic diseases, in its early phases PAD is asymptomatic and only 9% to11% of persons with PAD have the classic symptoms of intermittent claudication (ie, the occurrence of calf, hip, and/or buttock pain or discomfort on walking that is relieved with rest).[1,3,9,10] Critical limb ischemia (ie, the presence of pain at rest or ischemic nonhealing ulcerations and gangrene) represents only 1% of the general population older than age 50.[1,3,9,10] Whether these clinical presentations apply also to Hispanics is unknown. The diagnosis of PAD based only on clinical findings is, therefore, inadequate.

Noninvasive techniques for screening and detecting PAD

Ankle-brachial index. Diagnostic intra-arterial angiography is the gold standard test for the diagnosis of PAD, which is anatomically and angiographically defined as occlusion or stenosis of 50% or more in a major leg artery.[27,28] Because angiography is an invasive procedure with inherent risk, discomfort, and cost, noninvasive arterial studies are used preferentially to detect PAD. The most widely used definition of PAD in epidemiologic studies is a resting ABI of less than 0.90 (ie, the ratio of the ankle systolic blood pressure and the higher of the two brachial

systolic pressures is less than 0.90).[1,3] Although the 0.90 cut point is generally accepted, the actual diagnostic value of this threshold in the general population including different ethnic groups is unclear. In a subgroup of participants of MESA with normal ABIs (1.00 to 1.30), it was found that gender and ethnicity were independently associated with ABI.[29] In this cohort of 1775 healthy subjects, the ABI was about 0.02 lower in women than men and 0.02 lower in blacks compared with whites. These findings raise the question whether a single threshold for all gender/ethnic groups is then appropriate. Nevertheless, ABI values have important prognostic implications. Low ABI values have been associated with an increased risk of coronary artery disease, stroke, and cardiovascular death.[30] Even borderline ABI values (ABI 0.90 to 0.99) and low normal ABI values (ABI 1.00 to 1.09) have been associated with higher prevalences of subclinical coronary and cerebrovascular atherosclerosis as compared with an ABI of 1.10 to 1.30. Similarly, intermittent claudication, atypical exertional leg pain, and the incidence of mobility loss are more frequent among subjects with borderline ABI values than among those with ABI values of 1.10 to 1.40.[31,32]

The sensitivity of the ABI is 90%, and the specificity is 98% for an angiographically defined stenosis of 50% or more in a major leg artery according to small observational studies of patients with established PAD assessed prior to treatment.[33] The ABI may, however, underestimate the severity of disease in individuals with calcified, noncompressible arteries. Advanced calcific atherosclerosis of vessels beneath the cuff resists compression that results in falsely elevated ankle–brachial pressure indices (ABI > 1.30).[34,35] This calcification in the arterial walls is frequent in diabetics and in individuals with chronic renal failure or advanced age. As diabetes is highly prevalent among Hispanics, the use of ABI to detect the prevalence of PAD in this population may not be accurate. Alternative arterial studies, such as the toe-brachial index (TBI) and pulse volume recording measurement, have been suggested to detect PAD in individuals who are at risk for lower extremity PAD and have an ABI greater than 1.30.[33] Most epidemiologic studies, however, have excluded individuals with ABI greater than 1.3, which clearly underestimates the true prevalence of PAD, as angiographically defined stenosis of 50% or more in major leg arteries may occur in the presence of severe calcification and high ABI.[8,33]

TBI. This test is performed by placement of a small occlusive cuff on the proximal portion of the great or second toe using plethysmography to detect the return of toe pulsatility, which is a function of the systolic perfusion pressure. The TBI is calculated as the ratio of the toe systolic blood pressure and the higher of the two brachial systolic pressures. In individuals with noncompressible arterial segments, which are frequent in diabetics and Hispanics, the ABI is spuriously elevated, and values in the normal range or greater than 1.3 may be obtained in the presence of PAD. In such individuals, diagnostic information to confirm or rule out the presence of PAD should be obtained by the measurement of the TBI. TBI values less than 0.7 are usually considered diagnostic for lower extremity PAD.[36,37] A recent study using ABI and TBI to evaluate the presence of PAD in 510 ambulatory patients (37% diabetics) revealed that ABI values > 1.40 were significantly associated with occlusive PAD. Of all the traditional cardiovascular risk factors, diabetes was the dominant risk factor for a high ABI.[38] TBI should therefore always be obtained in diabetics, as digital arteries are usually spared the calcinosis that alters compressibility of more proximal arteries. In another recent study on 1762 patients referred to a vascular clinic because of PAD symptoms, the prevalence of elevated ABI was 8.4%. In the subset of patients with elevated ABI, the prevalence of PAD defined as a TBI < 0.60 was 78.2% among subjects with an ABI > 1.4 and 83.5% among those with an ABI > 1.5.[39] According to a recent report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee, the prevalence of physician-diagnosed diabetes among Hispanics living in the USA is 11.1%, 11.3% for Mexican American males, and 14.2% for Mexican American females,[40] which is about two times higher than that in non-Hispanic whites and similar to that in non-Hispanic blacks (Table I). Furthermore, the prevalence of fasting glucose greater than 126 mg/dL in Mexican-American men unaware of being diabetic is much higher than that in non-Hispanic whites (6.0% vs 3.6%, respectively). The prevalence of diabetes increases with age, and it is estimated to be about 34% in Hispanics older than 65 years.[41] The current total prevalence of diabetes in the United States for all age, gender, and race/ethnicity groups is about 5.6%. However, by the year 2050, it is expected to increase to 12.0%. Increases are projected to be the largest for Hispanics (127%) as com-

Table I. Prevalence of diabetes mellitus by race/ethnicity and gender

Population group	*Prevalence of physician-diagnosed DM*	*Prevalence of undiagnosed DM*	*Prevalence of prediabetes*
Non-Hispanic white			
Men	5.8%	3.6%	32.0%
Women	6.1%	2.2%	18.7%
Non-Hispanic black			
Men	14.9%	4.7%	22.9%
Women	13.1%	3.1%	19.0%
Mexican Americans			
Men	11.3%	6.0%	28.5%
Women	14.2%	1.9%	23.6%

Undiagnosed Diabetes mellitus (DM) is defined here as those whose fasting glucose is ≥126 mg/dL but who did not report being told by a healthcare provider that they had DM.
Prediabetes is a fasting blood glucose of 100 to <126 mg/dL (impaired fasting glucose). Prediabetes includes impaired glucose tolerance.
Sources: Prevalence: Prevalence of diagnosed and undiagnosed diabetes: NHLBI computations from NHANES 2003-2006; extrapolation to the 2006 US population.
Prevalence of prediabetes: CDC Fact Sheet.43 CDC computations are from NHANES 2003-2006; extrapolation to the 2007 US population. Percentages for racial/ethnic groups are age-adjusted for Americans >20 years of age.

pared with non-Hispanic whites (99%) and non-Hispanic blacks (107%).[42] These data suggest that for the assessment of PAD in epidemiologic studies in elder Hispanic populations, the traditional ABI technique should be supplemented by the use of other noninvasive tests such as the TBI.

Pulse volume recordings. Pulse volume waveform analysis measurements are performed with a system that incorporates a pneumoplethysmograph (pulse volume recorder [PVR]). Pulse volume recordings are obtained using standard blood pressure cuffs at the thigh, calf, and ankle. Sensitive transducers detect small increases in pressure within the cuffs. These increases are caused by a slight increase in the volume of the extremity during systole. The resulting recording closely resembles arterial pressure wave tracings. The amplitude of the pulse volume wave reflects local arterial pressure, vascular wall compliance, the number of arterial vessels beneath the cuff, and the severity of atherosclerotic disease. A normal waveform has the following characteristics: sharp upstroke, tall systolic peak, presence of a dicrotic notch, and rapid runoff to baseline or narrow waveform. As the artery becomes more diseased, the waveforms change accordingly, first losing the dicrotic notch and then becoming wider and flatter.[43,44] PVRs can be measured easily and rapidly with the use of new FDA-approved portable computerized devices. However, to our knowledge, there are no community-based studies examining this technique to assess the prevalence of PAD in Hispanic populations. In non-Hispanic populations, community-based detection of PAD using PVRs may not be necessary, given the established accuracy of the ABI for PAD detection and the adequate access to health care among these populations that to some extent obviates the need for community-based screening. PVRs have the advantage of revealing distortions in pulse wave contour even in individuals with vascular calcification and may allow the detection of PAD when ABI is within normal range or greater than 1.3.[45] The addition of PVRs to the ABI and TBI for detection of PAD may decrease the false-positive results that could potentially occur when the ABI or the TBI are used exclusively for this purpose. A clear advantage of an accurate detection of PAD would be the avoidance of potential harms of screening, including false-positive results, labeling, and the adverse events associated with invasive testing. Moreover, the harms of unnecessary or excessive medical, interventional, and surgical treatment and their adverse events could potentially be reduced or eliminated by improving the accuracy of the screening tests.

Risk factor modification and treatment of PAD

In general, risk factors for PAD are similar to those for cardiovascular disease. PAD, in fact, shares a common atherosclerotic etiology with coronary artery and cerebrovascular disease. Of known risk factors, smoking is by far the most important, as smokers have a 7.5-fold increased risk of cardiovascular disease compared with nonsmokers.[1,33] Nevertheless, the prevalence of cigarette smoking among Mexican-American men and women is lower than that in other racial/ethnic groups (Table II). Other risk factors include diabetes, age, hyperlipidemia, renal failure, and hypertension. In Hispanics with PAD, the prevalence of tobacco smoking is lower, and the prevalence of diabetes is higher than those in non-Hispanic whites and blacks with PAD,[46] suggesting that diabetes is a stronger risk factor for PAD among Hispanics. Risk factor modification and control are effective forms of prevention. However, because age may not be modified, PAD will invariably continue to occur and affect the elderly. Additionally, since the prevalence of smoking among adults in the US remains approximately 25%, and the incidence and prevalence of diabetes continue to increase, it is estimated that a significant percentage of the US population, including Hispanics, will continue to be affected by PAD.[33]

Table II. Estimated prevalence of cigarette smoking among adults aged ≥ 18 years by gender and race/ethnicity

Population group	*Prevalence of cigarette smoking (%)*	*95% confidence interval*
Non-Hispanic white		
Men	23.1	21.6-24.6
Women	19.8	18.7-20.9
Non-Hispanic black		
Men	24.8	22.0-27.6
Women	15.8	13.7-17.9
Hispanic		
Men	18.0	15.5-20.5
Women	8.3	6.7-9.9
Non-Hispanic American Indian/Alaska Native		
Men	36.7	19.9-54.5
Women	36.0	20.2-51.8

Source: CDC. Cigarette smoking among adults—United States, 2007. MMWR 2008;57:1221-26. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5745a2.htm.

The devastating effects of lower-extremity PAD may be preventable. The efficacy of interventions to prevent PAD is not well known, but exercise training, smoking cessation, aspirin and antiplatelet therapy, and lipid-lowering drugs may each be effective in managing the condition.[8] Effective risk factor modification and control in individuals with PAD may also reduce associated cardiovascular morbidity and mortality.[8] Consequently, smoking cessation and effective treatment of diabetes, hyperlipidemia, and hypertension should be pursued in all individuals with PAD. The presence of PAD may also be an indication for broad management of vascular risk factors because of its association with stroke, myocardial infarction, and cardiovascular mortality. In fact, current cardiovascular risk stratification guidelines from the National Cholesterol Education Program (NCEP) Adult Treatment Panel report (ATP III) classify PAD as a coronary heart disease equivalent, meaning that patients with a diagnosis of PAD carry a risk for major coronary events equal to that of established coronary heart disease (ie, 20% per 10 years).[47] Nevertheless, studies suggest that individuals with PAD are less aggressively

managed than those with cardiovascular disease.[8] In fact, a recent prospective cohort study established that among individuals with established arterial disease or with multiple risk factors for atherosclerosis, individuals with PAD experienced the highest rate of cardiovascular death and major cardiac events and stroke.[48] Despite the increased cardiovascular risk associated with PAD, this disease is commonly underdiagnosed and undertreated.[33,49,50] Continuous supervised and compliance enhancement programs within the community have the potential to improve the treatment and outcomes of PAD, particularly among Hispanics.

Exercise therapy for patients with PAD

Individuals with PAD do benefit from exercise therapy. A recent Cochrane review of 10 randomized trials of exercise therapy estimated an overall improvement in walking distance of about 150% in individuals with intermittent claudication, the classic form of symptomatic PAD.[51] The exercise component in all but one of these trials was supervised. In a meta-analysis of 18 randomized and nonrandomized trials, the greatest benefit was associated with continued walking until pain was nearly maximal and with sessions that lasted longer than 30 minutes, took place three or more times per week, and continued for at least 6 months.[52] Others have recently reported that higher physical activity levels during daily life are associated with less functional decline among people with PAD.[53] Although few randomized trials have directly compared supervised and unsupervised exercise training, several observational studies have failed to show significant functional improvement with unsupervised exercise consisting of advice alone.[54,55] Of interest, the latest American College of Cardiology/American Heart Association (ACC/AHA) Guidelines for the management of PAD suggest that treadmill exercise appears to be more effective than other exercise modalities, presumably because "treadmill walking most closely reproduces walking in the community setting."[33] No specific recommendation for community-based walking programs was, however, included within the Guidelines.

In addition to symptomatic improvements, exercise also has the potential to reduce cardiovascular risk. Physical inactivity is indeed an independent risk factor for cardiovascular events, whereas exercise can favorably improve lipid profile and glucose metabolism and reduce blood pressure.[56] Nevertheless, a recent report on national statistics on heart disease and its risk factors revealed that Hispanic adults were more likely not to engage in vigorous activity (71.8%) than non-Hispanic adults (59.5%).[40] Recent data from the National Center for Health Statistics reveal that Hispanics report higher levels of physical inactivity as compared with non-Hispanic whites and non-Hispanic blacks.[57] Similarly, the proportion of Hispanics engaging in at least one session of light/moderate or vigorous physical activity of at least 10 minutes, duration, or in regular leisure-time activity defined as three or more sessions per week of vigorous activity lasting at least 20 minutes or five or more sessions per week of light/moderate activity lasting at least 30 minutes in duration was lower than the proportion of non-Hispanic whites and blacks engaging in similar activities (Table III). Community-driven walking programs could be a mechanism to encourage physical activity and improve cardiovascular fitness among minority groups. To our knowledge, however, those programs have not been investigated or reported.

Table III. Leisure-time physical activity among adults 18 years of age and over, by selected characteristics: United States, 2006

Population group	*Inactive*	*Some leisure-time activity*	*Regular leisure-time activity*
Hispanic or Latino	53.4 (1.1)	23.8 (0.9)	22.8 (0.9)
Mexican	53.9 (1.5)	24.2 (1.1)	22.0 (1.2)
Not Hispanic or Latino	37.3 (0.7)	30.4 (0.5)	32.3 (0.5)
White only	35.3 (0.7)	31.0 (0.5)	33.8 (0.6)
Black or African American only	49.0 (1.3)	26.4 (1.0)	24.7 (1.0)

Values are presented as percentage (standard errors).
Source: CDC/NCHS, National Health Interview Survey, family core and sample adult questionnaires.
Reference: Health, United States, 2008 with Chartbook. Hyattsville, MD: National Center for Health Statistics; 2009.

Pharmacologic therapy for PAD

Pharmacologic therapy for PAD is primarily tailored to meet current guidelines for risk factor modification.[58] Current evidence demonstrates that PAD symptoms, walking distance, and quality of life can be improved by smoking cessation (physician advice, nicotine replacement therapy, and bupropion), cilostazol, and angiotensin-converting enzyme inhibitors.[58] Statin drugs in particular have demonstrated benefit in improvement in claudication symptoms, ambulatory ability, total walking distance, and leg functioning[59,60] even after adjustment for confounders.[61] The risk of major cardiac and cerebrovascular events can also be further reduced through lowering blood pressure with angiotensin-converting enzyme inhibitors and other antihypertensive drugs, use of statins, antiplatelet therapy with aspirin or clopidogrel, and probably by stopping smoking. Beta-blockers are effective as antihypertensive therapy and are not contraindicated in individuals with PAD. Antiplatelet therapy with aspirin (75 mg to 325 mg daily) reduces the risk of death from coronary events and stroke in individuals with cardiovascular diseases by 25% and is recommended for individuals with PAD.[58] Currently two drugs, pentoxifylline and cilostazol, have been approved by the FDA for the treatment of intermittent claudication, which is only manifested by a small proportion of individuals with PAD.[3,58] Although the pharmacologic treatment of PAD is well-established, the frequency and adequacy of these therapies among Hispanics are unknown.

Recent epidemiologic data reveal ethnic disparities in the prevention and treatment of other cardiovascular diseases related to PAD and that Hispanics are much less likely

than non-Hispanic whites to be screened and treated for lipid abnormalities and other cardiovascular risk factors. A study using data from the Third National Health and Nutrition Examination Survey revealed that African Americans and Mexican Americans were less likely to report serum cholesterol screening than whites. Even when identified as having high cholesterol that required medication, African Americans and Mexican Americans were less likely than whites to be taking cholesterol-lowering agents.[62]

In the San Antonio Heart Study, Mexican-Americans were less likely than whites to be aware of and to be undergoing treatment for high cholesterol.[63] In the 1988-1990 Behavioral Risk Factor Surveillance System (BRFSS), African Americans and Hispanics were less likely than whites to report cholesterol screening.[64]

Endovascular and surgical treatment of PAD

Revascularization (endovascular or surgical) therapy is reserved for lifestyle-limiting claudication and lack of response to exercise or pharmacotherapy whenever the risk-benefit ratio with revascularization is favorable. Endovascular treatments are minimally invasive catheter-based procedures, which include primarily percutaneous transluminal angioplasty (PTA) with or without stenting. Surgical revascularization is reserved for more advanced forms of PAD, usually when limb-threatening ischemia develops.[33]

Both surgical revascularization and PTA are effective in improving ABI values, functional status, walking ability, and quality of life in patients with claudication.[65,66] A prospective, observational study in 60 patients undergoing surgical bypass grafting and 44 patients undergoing PTA demonstrated that the ABI increased an average of 0.36 in the open bypass group and 0.23 in the PTA group. Over an 18-month follow-up period, both groups had similar improvement in physical functioning and walking.[65] A second prospective study looking at quality-of-life outcomes in patients treated with PTA for claudication and critical limb ischemia revealed that after 1 year of follow-up, maintenance of independence and ambulation status along with other daily physical functions was significantly improved.[66]

Although multiple factors such as young age, diabetes mellitus, and smoking play a role in early graft failure, there is some evidence that race may have an effect on the durability of lower extremity revascularization. In a large retrospective review of almost 15,000 patients undergoing lower extremity revascularization, it was found that the rate of early graft failure was higher in blacks as compared with Caucasians (6.7% vs 4.5% respectively).[67] In fact, blacks are found to be 1.7 times more likely to undergo primary and repeat amputation than Caucasians.[68] Although more attention has been given recently to PAD and outcomes of minorities,[69] few studies have tried to look at Hispanics separately. A recent multiethnic study of infrainguinal bypass for patients with claudication, rest pain, and tissue loss revealed that after a mean follow-up period of 18 months, Hispanics and blacks showed poorer outcomes.[70] The patency rate was 46.9% and 59.9% for Hispanics and Caucasians, respectively, while the limb salvage rate was 72.6% and 90.8% for Hispanics and Caucasians, respectively. Interestingly, most Hispanic patients were treated for tissue loss (86%) and had a higher incidence of diabetes mellitus. A second study attempted to more selectively compare the differences in treatment and outcomes of Hispanics and Caucasians for PAD.[71] Patients who underwent lower extremity revascularization with diagnoses of rest pain, ulceration, and gangrene were included in the limb-threatening group. Hispanics were significantly more likely to present with limb-threatening ischemia. In addition, these patients tended to have poorly controlled diabetes and experienced function-limiting pain starting at a younger age. Both factors are associated with more advanced presentation, resulting in limited therapeutic options (ie, PTA) and an increased likelihood to undergo a primary amputation. Finally, a more recent study that compared the results of autogenous infrainguinal bypass grafting in a multiethnic cohort of 1646 patients provided evidence of inferior outcomes in Hispanics treated for PAD.[72] Hispanics had lower rates of primary patency and limb salvage than whites despite similar rates of critical limb ischemia, and Hispanic ethnicity was an independent predictor of limb loss.

Although current evidence reveals that Hispanic patients with lower extremity arterial disease exhibit poor outcomes after revascularization, little data exist to explain possible differences related to type of repair, open surgical bypass vs PTA/stenting. This question may remain until the classic clinical picture changes: fewer patients presenting with advanced arterial limb disease. Although to some extent, the problem seems to fall back to socioeconomic factors (ie, limited education and access to proper preventative and diagnostic care), recent evidence indicates that ethnic and racial differences in the natural history of PAD may still occur after adjusting for socioeconomic differences or when these are nonexistent.[73,74] Small improvements may, however, change the overall Hispanic population presenting with vascular disease, thereby resulting in earlier diagnosis with more therapeutic options and better outcomes.

CLINICAL RESEARCH SUPPORTING COMMUNITY-BASED INTERVENTIONS IN HISPANICS

A community is commonly defined as a group of people with diverse characteristics who are linked by social ties, share common perspectives, and engage in joint actions in geographical locations or settings. Community context has been identified as an important determinant of health outcomes. This fact has increased the interest in community collaboration as an important strategy for successful clinical research and public health programs.[75] Community-based participatory research (CBPR) is a collaborative process of research involving researchers and community representatives. In this process, community-based organizations or groups (such as churches and other social organizations) help researchers in different steps of the research project, including recruitment of individuals.[76]

CBPR may be the most appropriate approach to study ethnic minorities because it overcomes barriers for limited

access to health care and increases the possibility of overcoming distrust of research on the part of communities that have historically been "subjects" of such research.[77] Precedents for community-based trials of risk-factor modification have been established in the prevention and treatment of diabetes and cardiovascular disease. In a study of Hispanic women comparing provider counseling and health education versus the combination of counseling, education, and support from a lay health promoter (LHP), individuals receiving a combined community and certified diabetes nurse educator intervention were more likely to complete diabetes education than controls;[78] those receiving printed nutrition education materials and LHP visits had lower total fat and saturated fat than those receiving printed materials alone,[79] and attendance at annual health screening was greater among Hispanics receiving an LHP visit compared with those receiving a postcard-only reminder.[80] Among African-American men, when an education and referral intervention was compared with a team approach consisting of a nurse practitioner, physician, and LHP, the team approach decreased blood pressure and progression of left ventricular hypertrophy.[81] Similarly, a community-based nurse practitioner and LHP team lowered global cardiovascular risk among black families with a history of premature coronary artery disease and increased the likelihood of achieving target levels of low-density lipoprotein cholesterol and blood pressure compared with an enhanced primary care delivery method.[82] In another study testing a team approach, those randomized to a nurse case manager and LHP team had improved triglycerides and diastolic blood pressure compared with those receiving usual care.[83] Available observational studies assessing vascular risk factors between Hispanics and other ethnic groups have included primarily hospital-based and epidemiological studies, which are prone to individual selection bias. Community-based studies are necessary to convincingly answer the important questions regarding vascular differences and their treatment implications between ethnic and racial minorities. To our knowledge, there are no studies that evaluate PAD in Hispanic communities using a CBPR approach. Recent research demonstrates, however, that CBPR has been successfully used in other medical conditions. A study revealed that the use of lay health promoters was effective for addressing cardiovascular disease risk factors among Hispanics living in the US-Mexico border region. The implementation of this community-based intervention program revealed positive changes in behavioral factors as well in low-density lipoprotein cholesterol level, triglyceride level, waist circumference, diastolic blood pressure, weight, and glycated hemoglobin among the participants.[84] Other studies have provided additional information about the effectiveness of CBPR methodology and the role of lay health workers for cardiovascular disease prevention and prevention and treatment of diabetes mellitus among Hispanics.[78,85]

CONCLUSIONS

PAD is a prevalent major public health problem that substantially affects quality of life and increases the risk of cardiovascular events and stroke in all populations. Although several epidemiologic studies have assessed the prevalence and natural history of PAD among non-Hispanic whites, and to a lesser extent in African-Americans, scarce information is available about the disease in Hispanics. Health disparities — the differences in incidence, prevalence, mortality, and burden of disease that exists among specific population groups — persist in the US. The true prevalence of PAD in Hispanics is unknown in part due to the limited access of this ethnic group to the health care system. In addition, the fact that the standard screening test for PAD, the ABI, may not be reliable in individuals with diabetes, which is highly prevalent in Hispanics, may significantly contribute to the imprecise estimate of the true prevalence of PAD among this minority. A critical need of research studies exists to define the true prevalence and natural history of PAD in Hispanics.

Effective methods of improving functional outcomes and quality of life in individuals with PAD have been documented. As the population ages and the incidence of PAD increases, there will be an inevitable increase in the cost and utilization of resources for the treatment of the disease. In Hispanics and other minorities with limited access to health care, community-based interventions such as supervised exercise therapy and risk factor modification could potentially reduce the burden and cost of the health care system.

AUTHOR CONTRIBUTIONS

Conception and design: CT, ER, GC
Analysis and interpretation: CT, ER, KK, GP
Data collection: CT, ER, KK
Writing the article: CT, ER, KK, GP
Critical revision of the article: CT, ER, KK, GP
Final approval of the article: CT, ER, KK, GP
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